Claims

What is claimed is:

1. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics, the apparatus comprising:

a laser having non-ideal tuning characteristics;

at least three interferometers positioned in an operable relationship to the laser, wherein a sampling interferometer and at least one auxiliary interferometer correct for residual errors resulting from the laser; and wherein a measurement interferometer makes a measurement;

a signal acquisition system positioned in an operable relationship to each interferometer; and

a processor positioned in an operable relationship to the signal acquisition system.

2. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 1, wherein the measurement interferometer has a device under test positioned therein.

3. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 1, wherein the sampling interferometer is a Michelson interferometer.

4. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 3, wherein the Michelson interferometer comprises Faraday Rotating Mirrors.

5. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 1, wherein errors due to third order phase effects in the laser are corrected by the equation

$$q_1(t) = z(t) - \frac{d_1 - d_0}{a_1 - a_0} w(t) - \frac{(d_1 - d_0)(d_1 - a_1)}{(b_1 - b_0)(b_1 - a_1)} \left[ x(t) - \frac{b_1 - b_0}{a_1 - a_0} w(t) \right];$$

where w, x and z are phase signals and where:

$$\begin{aligned} w(t) &= f(t - a_1) - f(t - a_0) \\ x(t) &= f(t - b_1) - f(t - b_0) \\ z(t) &= f(t - d_1) - f(t - d_0) \end{aligned}$$

and $a_1$, $a_0$ , $b_1$, $b_0$ ,and $d_1$, $d_0$ are path lengths.

6. An apparatus for measuring correcting errors generated by a laser with non-ideal tuning characteristics according to claim 1, wherein fourth order terms are corrected by the equation:

$$q_2(t) = z(t) - \frac{(a_0 - d_1)(b_1 - d_1)(c_1 - d_1)}{(a_0 - a_1)(a_1 - b_1)(a_1 - c_1)} w(t) - \frac{(a_0 - d_1)(a_1 - d_1)(c_1 - d_1)}{(a_0 - b_1)(b_1 - a_1)(b_1 - c_1)} x(t) - \frac{(a_0 - d_1)(a_1 - d_1)(b_1 - d_1)}{(a_0 - c_1)(c_1 - a_1)(c_1 - d_1)} y(t)$$

where w, x, y and z are phase signals and where:

$$\begin{aligned} w(t) &= f(t - a_1) - f(t - a_0) \\ x(t) &= f(t - b_1) - f(t - b_0) \\ y(t) &= f(t - c_1) - f(t - c_0) \\ z(t) &= f(t - d_1) - f(t - d_0) \end{aligned}$$

and $a_1$, $a_0$ , $b_1$, $b_0$ ,$c_1$, $c_0$,and $d_1$, $d_0$ are path lengths.

7. A method for correcting errors generated by a laser with non-ideal tuning characteristics, the method comprising the steps of:

a) providing a laser having non-ideal tuning characteristics;

b) positioning at least threeinterferometers in an operable relationship to the laser, wherein a sampling interferometer and at least one auxiliary interferometer correct for residual errors resulting from the laser, and wherein a measurement interferometer makes a measurement;

c) positioning a signal acquisition system in an operable relationship to each interferometer; and

d) positioning a processor in an operable relationship to the signal acquisition system.

8. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 7, wherein the sampling interferometer is a Michelson interferometer.

9. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 8, wherein the Michelson interferometer comprises Faraday Rotating Mirrors.

10. A method for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 7, further comprising the steps of :

measuring a phase difference between two different optical path lengths using the sampling interferometer; and

measuring a phase difference between two different optical path lengths using the auxiliary interferometer wherein the optical path length difference of the auxiliary interferometer is different from the optical path length difference of the sampling interferometer.

11. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 10, wherein the sampling interferometer is a Michelson interferometer.

12. An apparatus for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 11, wherein the Michelson interferometer comprises Faraday Rotating Mirrors.

13. A method for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 7, wherein errors due to third order phase effects in the laser are corrected by the equation:

$$q_1(t) = z(t) - \frac{d_1 - d_0}{a_1 - a_0} w(t) - \frac{(d_1 - d_0)(d_1 - a_1)}{(b_1 - b_0)(b_1 - a_1)} \left[ x(t) - \frac{b_1 - b_0}{a_1 - a_0} w(t) \right];$$

where w, x and z are phase signals and where:

$$w(t) = f(t - a_1) - f(t - a_0)$$
$$x(t) = f(t - b_1) - f(t - b_0)$$
$$z(t) = f(t - d_1) - f(t - d_0)$$

and $a_1$, $a_0$ , $b_1$, $b_0$ ,and $d_1$, $d_0$ are path lengths.

14. A method for correcting errors generated by a laser with non-ideal tuning characteristics according to claim 7, wherein fourth order terms are corrected by the equation:

$$q_2(t)=z(t)-\frac{(a_0-d_1)(b_1-d_1)(c_1-d_1)}{(a_0-a_1)(a_1-b_1)(a_1-c_1)}w(t)-\frac{(a_0-d_1)(a_1-d_1)(c_1-d_1)}{(a_0-b_1)(b_1-a_1)(b_1-c_1)}x(t)-\frac{(a_0-d_1)(a_1-d_1)(b_1-d_1)}{(a_0-c_1)(c_1-a_1)(c_1-d_1)}y(t)$$

where w, x, y and z are phase signals and where:

$$\begin{aligned} w(t)&=f(t-a_1)-f(t-a_0)\\ x(t)&=f(t-b_1)-f(t-b_0)\\ y(t)&=f(t-c_1)-f(t-c_0)\\ z(t)&=f(t-d_1)-f(t-d_0) \end{aligned}$$

and $a_1$, $a_0$ , $b_1$, $b_0$ ,$c_1$, $c_0$,and $d_1$, $d_0$ are path lengths.